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‡‡Auburn	2,050
Barber	200
**Belmont	600
Belvedere	350
Benicia	2,500
**Berkeley	42,000
Big Oak Flat	150
Biggs	750
Black Diamond	500
Brentwood	200
Brighton	100
Broderick	500
‡Brown's Valley	50
**Burlingame	5,000
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Cement	1,500
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Davenport	1,000
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Decoto	350
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Dobbins	50
Drytown	100
Durham	500
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**East San Jose	1,500
Eckley	20
Emerald	50
Elmhurst	2,500
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DE SABLA AND CENTERVILLE POWER PLANTS

BY ARCHIE RICE.

Birdseye View of the De Sabla Power Plant on Butte Creek in Butte County, California.

Archie Rice

The black mule team sloshed through patches of snow. Towering pines stood sentinel-like along the lofty tableland. Forests and vistas of evergreen ridges on all sides suggested vast solitudes close up under the gray vault of the heavens.

Then the road descended and serpentined down and down. The sure-footed blacks never slackened their speed. We took the turns at almost a runaway rate. Each outer sweep close to the edge of the deep, sloping canyon brought its instinctive thrill. What might happen should an animal stumble, a wheel come off! The whole outfit would go tumbling, bounding, smashing, and mangling down, down, down, nearly a mile into the depths.

Five miles of that winding descent and we were finally at the bottom of the defile, but only a little more than a mile from the mountain lake up in the forest whence we had started.

A building gleaming silvery white clung on a blasted-out shelf at the edge of the stream. The surrounding brown and dense foliage greens and the varicolored rock strata of the precipices made this work of man stand out glaringly in a scene wonderful for its

natural picturesque beauty. No photograph can do it justice. The place is a bit of Switzerland with a touch of the Grand Canyon of Arizona.

The noise of thundering waters was akin to the incessant muffled boom and moan of the mighty Yosemite Falls. Spray-clouds rose out of the gorge by the silvery building and covered half an acre with mist like fine drizzling rain. But where was the waterfall?

Monster underground steel pipes coming 6000 feet down the slopes were carrying torrents of water from that mountain lake and shooting with tremendous force against water wheels under the building. The noise of waters, the rocketing and crashing were the escaping jets darting across and fighting and gradually conquering and loosening the granite masses of the opposite bank.

Here was the De Sabla power house. In that silvery building were being constantly generated 17,420 electrical horsepower, enough energy to maintain continuously and all together 260,000 electric lights of sixteen-candle-power each.

This was Butte creek, in the northern part of Butte County, in the northeastern part of California. All that thundering water flung into the stream was but a temporary loan. Down a little way a dam diverts it into a ditch and flume system that winds by a gentle descent for eight miles and then drops the water nearly six hundred feet perpendicularly through big steel pipes to propel wheels that generate 8576 electrical horsepower at another plant called the Centerville power house.

Then the creek finally receives the twice-worked water and goes winding meekly on down some twenty miles or more to make its contribution to the main river of the Sacramento valley. On flow those waters for many miles into San Francisco bay. They go out with the tide through the Golden Gate into the mighty Pacific. Abundant sunshine takes up the ocean moisture. The trade-winds waft the saturated atmosphere far inland. The towering white crests of the great wall of the Sierras check the clouds, chill them, and take tribute in myriad snowflakes to renew California's mountain streams and rivers. Nature in her bounty is nowhere wasteful.

California's inland rampart is the lofty wall of the Sierra Nevada Mountains. The slope is steep and high. It is gashed with streams that come down suddenly into the great interior valley. Heavy rains in the forest regions and melting snows in the summer maintain the flow of waters, and here and there man has built storage reservoirs to guard against the shortage of a possible dry season. Such are the conditions that have made California wonderfully rich in mountain water power, in matchless possibilities for hydroelectric development.

Way up toward the right-hand corner of the map of California is Butte County. It is an area larger than the state of Rhode Island. Its eastern edge follows the crests of the lofty Sierra. On the west it skirts the Sacramento river down in the great valley. But as a whole it is two-tenths mountains, heavily timbered; five-tenths foothills, rolling, piling slopes of partially bald or oak-timbered country; and three-tenths fertile valley lands, where grow the orange and the olive in great productiveness and where the rain seldom varies from an annual fall of twenty-five inches. The Feather river divides the county, and Butte creek, on which stand the De Sabla and Centerville electric power plants, cuts diagonally down across its northern third.

To reach these two power plants we went by rail to Chico, a community of about 12,000 people and the principal city of Butte County. Thence we climbed some 2500 feet up into the Sierras on the Butte County Railroad, winding gradually up and up, through Paradise and on to Magalia, where the mule team was to meet us. Magalia is a station near the top of a ridge, and the immediate outlook is down into densely forested canyons. Five miles away through the forest is Camp One, at the storage lake that supplies water to the hydraulic plants. But from the Centerville power plant we drove back to Chico by wagon road a dozen miles or more down along Butte Creek and then across the valley country.

Those two plants delivering their electricity into the same power line of three big aluminum wires at an intensity of 60,000 volts, supply many industries, light many towns, and send their subtle energy even to a distance of two hundred miles to communities about San Francisco bay.

The smaller plant at Centerville is the older one Back in 1898 the Butte County Electric Power Company was incorporated by O. W. Meysenberg, Judge J. A. Waymire, S. C. Dennison, H. B. Snow and C. C. Jones. Work was started at once on the proposed plant, but it was continued leisurely. In February of 1900 H. W. Heath became a director in the company and Park Henshaw, by reason of his large investment, was elected president. The power house was completed, and a transmission line to Chico was ready for service in May of 1900. The entire investment up to that time had been $175,000.

The plant started with two transmission lines in operation. One was to Chico, fourteen miles. The other was thirty-two miles to Oroville and the gold dredges on the Feather river. This gave a total transmission service of forty-six miles. In August of 1910 the line to Chico was continued down the Sacramento valley to Colusa forty miles. An independent line was also run from the power house to a junction with the Chico-Colusa line. Thus the system consisted of three main-line pole-lines from the power house, and all were of copper wire throughout, with an aluminum cable extension for the Oroville dredging district. Telephone lines were put on all the pole-lines and these telephone wires were transferred every tenth pole. When this power plant and the company controlling it were bought by the founders of the De Sabla system the Centerville power house was delivering four hundred kilowatts to Chico through two 200-kilowatt transformers, one hundred and fifty kilowatts to Gridley through two 75-kilowatt transformers, one hundred kilowatts to Colusa through two 50-kilowatt transformers, and about five hundred horsepower to the gold dredges on the Feather river.

Improvements and developments had been planned for the Centerville plant, but they were not made until after the transfer to the new ownership. The original

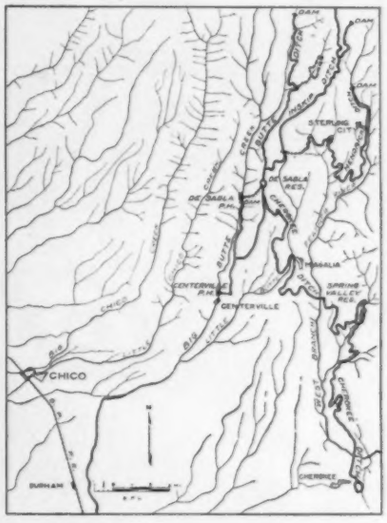
machinery was all mounted on heavy cast-iron floor plates set in masonry foundations. Soon after the larger concern had absorbed this plant it introduced extensive improvements, put in more machinery, added to the water-power, and generally increased the value and effectiveness of the property.

But how came the De Sabla power plant to be City back in 1895-6, and helped found and finish the great Colgate power plant in 1899.

Here is his story of why and how the De Sabla power plant came to be established:

"About the year 1903 the management of the Bay Counties Power Company realized that the capacity of its system, which then consisted of the Nevada County

The De Sabla Power Plant, Showing the Boarding-House in the Background.


DAM
DAM
DAM
STERLING CITY
DE SABLA RES.
DE SABLA P.H.
PARADISE
CENTERVILLE P.H.
CENTERVILLE
SPRING VALLEY RES.
CHICO
BUTTE
BUTTE
BUTTE

system. The Bay Counties Power Company had already acquired a water right on French creek, a stream emptying into the Feather river at a point a short distance below the present power house of the Great Western Power Company at Big Bend. The superintendent of the Bay Counties Power Company at that time was L. M. Hancock, and his first assistant was T. E. Thebreath. On that trip to French creek I took T. E. Thebreath with me.

"We then outlined a plan of development. It consisted of the building of a restraining dam in French Creek valley. The restraining dam was to form a lake, which, to the best of my recollection, would have held about 500,000,000 cubic feet of water. The water from this lake was to have been taken through a tunnel. The tunnel was to have been constructed through the range of mountains separating the proposed lake from the Feather river. The tunnel was to have been about a mile and a half long. A pipe-line about 6000 feet long was to have been constructed. This would have given a fall of about 1200 feet, and a capacity at the power house of about 10,000 kilowatts, or 13,400 horsepower.

"We then formed the Butte County Power Company, with a capital stock of $1,000,000 and an authorized bond issue of $1,000,000 for the purpose of constructing this plant. The stock was to be owned by the Bay Counties Power Company, and the bonds were to be placed with some one of the bond firms.

"A camp had been started at French Creek, a lot of preliminary work had been done, roads had been built, and so forth. Practically all of the land in the reservoir site had been acquired, with the exception of one parcel. This unacquired area belonged to certain persons whom I knew personally and whom I had every reason to think would be friendly.

"I had practically placed the bonds with a San Francisco bond house. I then made a visit to French Creek to go over the proposed construction. While I was on the trip to the site the sale of the bonds was confirmed. I met the people who owned the small area of unpurchased land. It amounted to one or two hundred acres in the reservoir site, out of a total, which the reservoir would have covered, of about four hundred acres.

"These people then told me that they wanted $200,000 for their holdings, or half the stock of the Butte Counties Power Company. It was about as artistic a holdup as I had ever encountered. My only answer was to call for T. E. Thebreath, who was in charge of the construction, and immediately order him to close down all work, discharge all the men, and consider the French Creek development as a dead issue. I then, in front of the persons in question, turned to the representatives of the bond firm and informed them that the deal was off as far as they were concerned, as the Butte County Power Company was a dead issue, due to the exhorbitant price that was being asked for the one or two hundred acres of land in the reservoir site.

"Having in mind to purchase the water systems of the Cherokee Mining Company and also to purchase the Centerville plant, which was owned by the Butte County Electric Light & Power Company, I then formed the Valley Counties Power Company, with a capital stock of $2,500,000 and an authorized bond issue of $2,500,000. The bonds were to be guaranteed by the Bay Counties Power Company, and all of the business of the Bay Counties company in Butte County was to be turned over to the Valley Counties company, in consideration of which the Bay Counties company was to own all the capital stock of the new Valley Counties company.

"I therefore made arrangements and purchased the property of the Butte County Light & Power Company. Its holdings consisted of the now-existing Centerville Ditch, which has since been enlarged, and a plant, having a capacity of about 1000 kilowatts, with a pole-line to Oroville, where it had a contract with three or four gold dredges, and a pole-line to Colusa, where it had a contract with the Colusa local lighting system.

"I then purchased from the Melons of Pittsburg the entire water system of the Cherokee Mining Company, the principal value of which was that part of the system comprising the head-dam, located in Butte creek, with a water right of about 4000 miner's inches. The ditch was in comparatively good shape, but the flumes were so old that they were practically worthless.

"While walking down the ditch for an examination of this system with T. E. Thebreath and R. L. Harter, the company's surveyor, we came to the conclusion that the best method of development was to divert the water at a point which was known as and may yet be called Slater's Dam; then to take the water by pipe-lines down a precipitous mountain-side to Butte creek. We estimated there would be a fall of about 1600 feet.

"From the top of the hill we could just about see the in-take of the Centerville Ditch on Butte creek. We therefore realized that the water of the Cherokee system could be used over again by the Centerville system, thereby increasing very much the value of the property of the company.

"So we sent our rig, which had met us at that point, down to Centerville. After planning Slater's Dam and reservoir we started to go down the hill, looking for a location for the proposed pipe-line, with a view to finding out what kind of a place there would be on the edge of the creek below for a power house. When we finally got down there, at the bottom of a mile slope, we realized that we had a pretty hard proposition. It was nothing but rocks. Almost the entire area would have to be blasted out. But we decided upon a point at once and started a camp.

"In order to build the plant the first thing that I directed to be undertaken was the construction of the present road that winds several miles from the top of the hill down to the power house. All other parts of the work, from rebuilding the flumes and enlarging the ditches down to increasing the Centerville plant, were started simultaneously.

"The first money was raised from a subscription by some of the principal stockholders of the Bay Counties Power Company. It was at a meeting held in my office in San Francisco, and $500,000 in bonds were taken by John R. Coleman, Theodore Low, R. R.

The Main Ditch That Supplies the De Sabla Plant With Water Power.

Eugene de Sabla Jr.

Bull Teams Hauling Machinery to Build the De Sabla Power House.

Camp One, Near the Reservoir, High Above the De Sabla Power-House.

Jack and Buck, the Black Mule Team at De Sabla.

Colgate, R. M. Hotaling, John Martin, William Pierson, and myself. After that the financing of the company was accomplished by the sale of the bonds to the general public.

"Inside of, I believe, one year the De Sabla plant was completed and furnishing current to its customers in Chico and in the Oroville gold-dredging district, and was delivering its surplus energy to the lines of the Bay Counties Power Company.

"Most of the construction was under the supervision of T. E. Thebreath. But toward the end of the work L. M. Hancock, the general superintendent, had charge.

"To the best of my recollection, the distance between the head-dam of the Cherokee system and the penstock, or Slater's Dam, is about twelve miles, and the capacity of the ditch about 4000 or 5000 miner's inches.

"Since that time, however, there has been developed another water system called the Henderson Ditch, which is about twenty miles in length. It brings some of the waters from the west fork of the Feather river through a viaduct formerly owned by the Cherokee company and called the Toadtown Ditch. It joins the main De Sabla system at a point about a mile and a half above Slater's dam, thus practically affording the company a double water system.

"During the progress of the construction work, while I was in Europe, some of my associates named the plant after me, because of the part I had taken in the inception of the enterprise."

At first the De Sabla plant was referred to as the

Nimshew power house. That was before it was officially named. Nimshew is a tiny hamlet up in the mountains a few miles from Camp One; it is the nearest postoffice to the power house. The Nimshew Indians, now extinct, used to occupy that part of California, and even down to the early mining days they controlled all the region southward to the American river.

Work did go with a rush on that De Sabla plant. There was blasting for the power house foundations; tunneling down the slope for the pressure pipes, damming for the storage reservoir, and first of all the construction of that long winding mountain road down into the bottom of the canyon. The great pipes are anchored in cement blocks at thirty-three places, and one of these anchorages is a mass of masonry weighing one hundred tons. All these precautions had to be taken to insure rigidity, because the force of the down-rushing water in those tubes is about seven hundred and fifty tons.

Where the Water Is Diverted From Butte Creek Just Below the De Sabla Power-House Into the Ditch Leading Down to the Centerville Plant.

Looking Down Butte Creek. The Ditch to the Centerville Power-House Skirts the Left Bank.

Twenty and thirty miles back in the mountains, through the primeval forest and its solitudes, come the great water ditches. They unite and pour their flood into the forebay reservoir on top of the ridge, a pretty, forest-skirted, artificial lake covering an area equivalent to about five city blocks. From that little lake extend the mighty pressure pipes that take the water down the mountain side to drive the De Sabla wheels; and later to batter against the wheels down at the Centerville plant.

The interior of the De Sabla power house is a model of simplicity, and its transformers and high-tension gallery have been considered the most perfect piece of engineering construction in California.

Coming down the mountain side through Indian Spring ravine, close to the boarding house, is a rivulet that cascades and gushes and flashes its spray in the sunlight. That small creek is fed by several tributary rills. It supplies abundant water for cooling the transformers and the electrical generators and for fire purposes and the domestic needs of the little community that lives there hidden from the world in a wonderful beauty spot where day and night the dull roar of waters and machinery disturb the silent majesty of Nature in one of her sublimest aspects.

There is that beautiful stream, gushing among mighty boulders. A picturesque suspension bridge extends from the clubhouse across the canyon to the wooded slopes and to winding pathways under sweet-scented foliage. In the water are trout. On those difficult slopes are just such haunts as deer most favor.

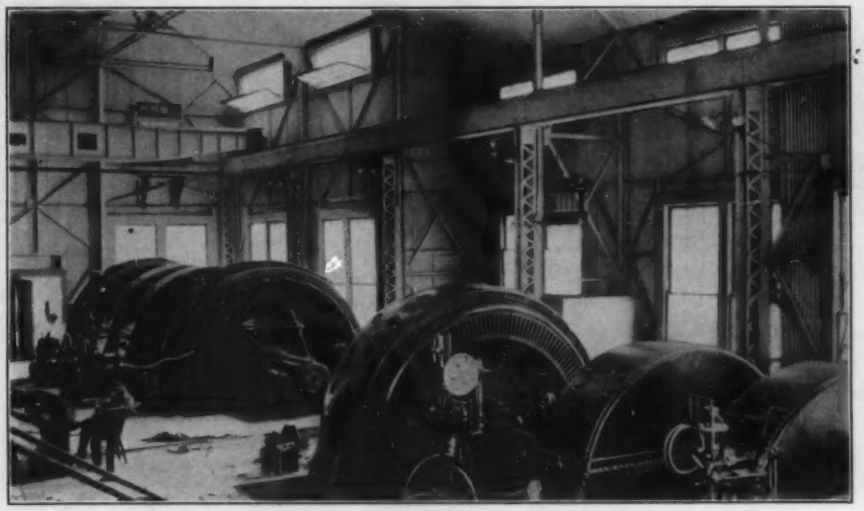
Some seventy feet up the hill above the power house are two large oil tanks, one containing oil for the transformers and the other the lubricating oil for the machinery and bearings. The fall creates a pressure and other devices increase it, so that oil is forced in everywhere to be sure that it penetrates well where speed is great and friction must not develop.

August 22, 1904, the fourth and largest generator was installed at the De Sabla power house to produce 5000 kilowatts. A new pipe-line was specially constructed parallel with the original one to drive the water-wheel that turns this powerful machine.

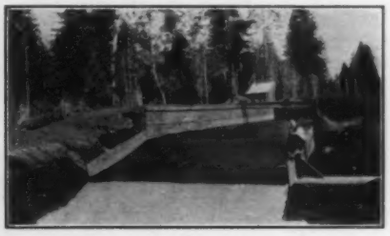
Early in 1906, after the amalgamated and augmented Bay Counties Power Company had become known as the California Gas and Electric Corporation, all its enterprises passed officially to the control and ownership of the Pacific Gas and Electric Company. In this transfer were involved the De Sabla and Center-

ville power plants, which are now part of the company's great hydroelectric system of eleven mountain generating stations and about one hundred electric distributing stations.

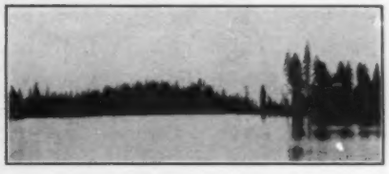
Comparatively few people will ever see the De Sabla power plant. It is difficult of access, isolated, apart. But its location is the most majestically beautiful place of all the spots where electricity is generated in California. As we rode up out of that canyon, the three silvery aluminum wires, thicker than a man's thumb, strung high overhead and pointing away to the southwestward, the thought came: if only more people down in the cities, those who use electric lights and enjoy the varied benefits of electric energy, could see this place and know something of the far-reaching waterways through the Sierra forest and the reservoir-lake and the pressure-pipe-lines, and that constant droning at the silvery building where water is doing the work of 17,000 horses, what an education it would be in the commercial development of natural resources, what a refining inspiration to gaze upon the varied beauties of that mountain scenery.



Generators in the De Sabla Power-House.



Hendricks Ditch Emptying Into De Sabla Forebay Reservoir.



Eighteen-Acre Forebay Reservoir Above DeSabla.

PHYSICAL DATA.	DE SABLA PLANT	CENTERVILLE PLANT.
Capacity of main storage reservoir	38,000,000 cu. ft.	same
Area of main storage reservoir	90 acres	same
Miles of main ditch and flume system	54.38	8.4
Miles of subordinate ditches and flumes	20	38.8
Flow the second in main ditch system	180 cu. ft.	190 cu. ft.
Pressure head (height of fall)	1,531 ft.	577 ft.
Force of water the square inch	664 lbs.	250 lbs.
Number of impulse wheels	4	1
Number of turbines	0	1
Capacity of generators in kilowatts	2,000; 2,000; 4,000; 5,000	900; 5,500
Total electrical horse power	17,420	8,576
Generating voltage	2,400	2,300 and 2,400
Voltage on power lines .....4.....	60,000	60,000
Altitude of reservoir	2,600 ft.	same
Altitude at power house	1,000 ft.	575 ft.
Size of power house	50 x 109 ft.	32 x 110 ft.
Material of building	Concrete foundation, steel frame, galvanized iron covering	Concrete walls, galvanized iron roof on steel frame
Plant placed in service	October 22, 1903	May, 1900

AIR NITRATE FERTILIZERS.

Frank and Caro, two German chemists, have invented a process through which, by combining nitrogen gas with calcium carbid at a temperature of 1,000° C., they could produce a combination of lime, carbon and nitrogen—in other words, a synthetic nitrate of lime—to which they gave the name of cyanamid of calcium, now commonly known as cyanamid, which contains from 15 to 20 per cent of nitrogen, 60 per cent of lime, and has qualities as a fertilizer similar to sodium nitrate, or Chilean saltpeter.

The calcium carbid therefore was ready, the process for converting it into cyanamid by combination with nitrogen was perfected, and it only remained to provide an adequate supply of atmospheric nitrogen at a moderate cost. This requirement was met by a process invented by Dr. Carl von Linde, of Munich, which was patented in both France and the United States. By this process atmospheric air, having been first liquefied by compression, is subjected, by subsequent expansion under pressure, to a process of fractional distillation, by which the nitrogen is separated, leaving as a by-product oxygen of 50 to 60 per cent purity, which can be used by burning in the electric arc for the manufacture of nitrates and nitric acid.

The cycle was now complete, and it is through the combination of these two processes—the Linde method for recovering atmospheric nitrogen and the Frank-Caro method of combining nitrogen with calcium carbid for the production of cyanamid of calcium—that European progress hopes to provide for the future an adequate supply of nitrate fertilizer for agricultural purposes.

CONSERVATION OF WATER POWERS.[1]

BY L. B. STILLWELL.

True conservation of our natural resources means wise utilization of those resources without unnecessary waste. Such utilization is the primary and essential business of the engineer. During the last twenty-five years, a period practically co-terminous with the life of this Institute to date, the art of transmitting power by electricity has grown from a laboratory experiment into a development universally recognized as one of the great factors of industrial and commercial life. A very large proportion of the water powers hitherto unappropriated are either located upon government lands or are dependent, wholly or in part, upon the run-off from government lands. The regulations established by national and state governments which control or affect the further utilization of water powers, therefore, are of peculiar concern to the members of this Institute. A bill endorsed by the adminjstration is now before Congress which, if passed, will confer definitely upon the President and his executive assistants full authority in respect of withdrawal of public lands and unappropriated water powers.

The Relation of Forests and Stream Flow.—The Bureau of Forestry has established regulations governing the appropriation of water powers located on streams which drain watersheds included in whole or in part in forest reserves. Among these regulations is the imposition of a graduated rental, to be paid by the individual or corporation appropriating the water power and used by the government for forest purposes. This rental rests upon the assumption that the appropriator of the power will be benefited by the preservation of the forest, and this idea is accepted generally by engineers and by the public. During the last two years, the question of the actual or assumed effect of forests on the watershed in regulating the run-off, has been widely debated. That forest cover controls the run-off to a material extent has been vigorously asserted by engineers prominent in the government service and by many others, and on the other hand, it has been seriously questioned by a number of our leading engineers. As regards that forest control which is practically related to the commercial value of water powers, the author believes the following to be a correct statement: While the aggregate annual run-off of our rivers in general depends upon the total annual precipitation, the presence of forest cover on the watershed regulates the rate of run-off to an extent which in many cases materially affects the value of the water-power, this regulation tending to equalize the flow and prolong it during the dry season.

The present form of permit provides a nominal charge (rental) for the land occupied by power house, dam, canals, penstocks, flumes, etc., the rate being "One dollar per acre and five dollars per mile for the land occupied by said works." It provides also that "the gross operation charge for any year shall be calculated by the forester upon the basis of the quantity of electric energy generated, in such year at a maximum rate, * * * * *" which amount progressively increases up to the fiftieth year. The maximum rates are applicable only in cases where all the water utilized comes from the forest reserve and the entire head developed results from the topography of the forest. In all other cases, deductions are made.

The Imposed Rates as a Tax on the Power Enterprises.—The proposed conservation charge, at least during the early years of the contract, cannot be regarded reasonably as constituting any very serious financial burden imposed upon the individual or corporation developing the water-power. If power be sold at an average price of one cent per kilowatt-hour, the maximum conservation charge during the first five years of operation is equivalent to a tax of 0.61 per cent of gross receipts. During the next five-year period, it is increased to 1.25 per cent and it increases gradually from this figure to a maximum of 3.25 per cent of gross receipts, which rate applies during the last five years of the fifty-year life of the contract. The average charge during the fifty-year period is 2.086 per cent of gross receipts. It is a fair question, however, whether a more rational method, and one which in certain important respects would tend to produce better results, might not be devised. The plan in force obviously is open to several objections. Among these are: (1) The imposition of a tax upon output means that the man who installs a highly efficient plant is called upon to pay a higher conservation charge than the man who wastes water by the installation of a cheap and inefficient plant. (2) The proposed method of charging imposes a heavier burden upon the man who sells his power at a low price than upon him who sells it at a high price. (3) Under the plan proposed by the Forest Service the man who takes his power to a market, say 100 to 300 miles away, must pay to the government for the losses incurred in doing so and pays more than the man who sells to the home market. While the method of applying the conservation charge has been criticised in many quarters and while the objections above pointed out are valid, the method in force possesses undoubted advantage in the fact that it is definite and readily determined by reference to records which the permittee can readily keep. The charges, moreover, are adjusted to encourage development of the water powers by recognizing the fact that few, if any, can earn interest on the necessary investment from the start. Except by reducing the average charge for the period, it would be difficult to devise a plan less onerous for the permittee. (4) While the imposed charge could not be regarded as excessive, if the power developed were entirely, or even very largely, dependent upon the preservation of forest cover upon the watershed, it represents a high rate when measured in a comparison with the increase in commercial value of the power, which, under ordinary conditions, is due to the forest. (5) The tax is imposed upon power from all forest reserve lands, regardless of the actual condition of the forest upon which it is based. Obviously, therefore, a uniform tax must be very much heavier in some cases than in others, as compared with the benefit upon which it theoretically rests. (6) It tends to retard utilization of water powers and stimulates the use of coal for power purposes—a result which is in direct contravention of the primary object of conservation. (7)

[1]Abstract of presidential address at annual convention A. I. E. E., June 28, 1910.

Something less than one-half the public domain is included within the limits of the forest reserves. To secure maximum revenue and to minimize the average retarding effect upon utilization of these water powers resulting from a system of rental, any charges which may be imposed by the Federal Government upon water-power appropriation should apply to all public lands.

The effect of forest cover in adding to the commercial value of a water power, results from two facts, first, that an increase in minimum run-off reduces the necessary investment in auxiliary steam or other power plant; second, that some portion of the flood waters, which otherwise would flow past the power plant, at a time when the water available exceeds the amount needed, is held back long enough to permit its commercial utilization.

Features of the Present Regulation Which Should Be Changed.—Clause 15 of the power agreement now in force reads as follows: "The permit here applied for shall be non-transferable, and shall be subject to all prior valid claims which are not by law subject thereto." The aim in view, of course, is to avoid monopoly, as a result of which an artificial price might be maintained higher than the average which would be fixed by competition of similar developments in the same market. If effective, it is obvious that this requirement must retard development. The economic reasons which demand that water powers on the same stream should deliver their output to the same network of distributing circuits in many cases are material, and those which demand that the output of developments on different streams should be similarly combined are even more weighty. By electrically combining the output of a considerable number of water powers, interruptions of service, due to accidents to flumes or to transmission circuits, are decreased. The clause should be modified by permitting transfer, subject to approval by the government.

Continuous Operation of Plant.—Clause 18 reads as follows: "The permittee shall, except when prevented by the act of God or the public enemy, or by unavoidable accidents or contingencies, continuously operate for the generation of electric energy, the works to be construed under the permit hereby applied for, in such manner as to generate after such generation begins," not less than certain percentages of the full hydraulic capacity of the works measured in kilowatt-hours. The object in view is to prevent a power company increasing its prices by creating an artificial power famine and to secure full utilization of the available power. Some permits have specified that not less than twenty-five per cent of the full hydraulic capacity must be generated; others as much as seventy-five per cent, depending upon special circumstances supposed to govern the case. In many cases this clause presents serious difficulty to the power company. If it be necessary to retain such a clause, it should be accompanied by a provision permitting, with the consent of the government, a reduction in the percentages originally fixed.

Term of Permit.—Clause 20 of the permit in force reads as follows: "The permit hereby applied for shall cease and be void, upon the expiration of fifty years from the date of approval hereof, but it may then be renewed in the discretion of the duly authorized officer or agent of the United States, and upon such conditions as he may in his discretion fix. * * * * *" This clause contains no provision for taking care of the contracts which may be in force between the permittee (or his successor) and his customers at the expiration of the fifty-year period. It is obvious that by its absence the value of the permit during the latter years of its life, is materially impaired. Power contracts are frequently, in fact generally, executed for periods of not less than five years and frequently for ten or ever twenty years. The contract agreement should include a clause guaranteeing for a period not less than five years subsequent to its termination, the fulfillment of contracts between the permittee and customers existing at that time.

The Permit Revocable.—Under the law as it now stands the Forest Service can grant to an individual or corporation seeking to develop water-power from forest reserves only a permit revocable by the Secretary of Agriculture in his discretion. No argument is necessary to demonstrate that a permit revocable in the discretion of the head of a department is not an adequate basis for financing an enterprise requiring investment of capital.

An Alternative Plan.—Assuming that upon careful consideration the American people should decide to impose a tax upon natural resources of the public domain, to be used in conserving and developing those resources, it is perhaps not improper to suggest the outlines of a plan which from the standpoint of public policy appears preferable to that now in force. The essential features of the plan which Mr. Stillwell suggests are the following:

(1) A tax imposed on all sources of power found upon public lands—a royalty on coal mined and a rental upon water-power. The charge for water-power to be based not upon an indefinite and disputed relation of forest covering and commercial value of the power, but upon the fact that the government needs revenue to develop and conserve our natural resources, owns the power, and, as owner, possesses an unquestionable right to impose a charge for its use. The Federal Government is now selling coal lands on the public domain at prices which, on the average, approximate one-tenth of one per cent per ton of the coal which it is estimated the property can commercially yield. If the coal be used to produce power under average conditions this tax is substantially equivalent to 0.5 cents per 1000 kilowatt-hours as against an average rental of 20.86 cents per 1000 kilowatt-hours now imposed in the case of water-power. The theory of conservation unquestionably points to an increase in the price fixed for coal lands or a decrease in waterpower rental, or both. The general features of the present contract agreement enforced by the Forest Service as regards fifty-year limit of the period of appropriation should be preserved. The other restrictions now imposed should also be retained except that certain clauses should be modified to meet the practical objections which have been pointed out.

(2) The charge imposed upon water powers should be based upon the amount of water appropri-

ated and the effective head resulting from the topography of the government lands concerned. Under the present plan, it is necessary to measure the water in order to fix the third deduction from the charge based upon output. The difficulty of measuring water, therefore, must be met and it is easy to fix the second-feet appropriated as to fix the deduction allowed for artificial storage by a permittee.

(3) The third suggestion is that the government engineers of the department of bureaus concerned develop comprehensive preliminary plans for the development of water powers of a given watershed and that these water powers collectively or severally be leased to the highest bidder, the government, of course, reserving the right to reject all bids.

THE WATTHOUR METER.

BY WM. M. SHEPARD AND ALLEN G. JONES.

(Concluded)

APPENDIX.

Fig. 2 is the vector diagram of a potential transformer. OE is the primary e.m.f. OE′ is the secondary e.m.f. OI is the primary current, OI′ the secondary

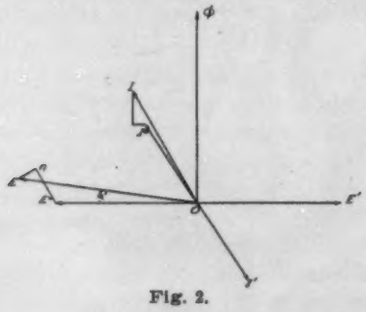


Fig. 2.

current and II′ the exciting current. E″N is the e.m.f. consumed by resistance or is the RI drop, EN the e.m.f. consumed by the reactance or is the XI drop, and EE′ is the impedance e.m.f. of the transformer. In the figure it will be seen that the secondary e.m.f. (OE″ referred to the primary) leads the primary e.m.f by an angle α'. This will tend to make the meter run slow on inductive loads.

Obviously, if α of the current transformer equals α' of the potential transformer there will be no error from this source, and it is attempted in the design of meter transformers to approximate this condition. For this reason considerable resistance is introduced into the potential transformer to increase this angle. This high resistance results in a transformer of poor regulation, but the regulation is not important, as the load is constant and the range recommended narrow.

In practice, the angle α of the current transformer is greater than the angle α' of the potential transformer. This difference can be compensated in the lag of the meter. Suppose, for example, the meter is not lagged properly by the angle ω. Then, if $\alpha - \alpha' - \omega = O$ there will be no error from this source. In other words, the meter is lagged so that it will run slow on inductive loads. The combined effect of angular displacement in the potential transformer and of the meter not being lagged quite ninety degrees just compensates for the angular displacement of the current transformer.

These angles may be determined and corrections made as follows: The results obtained by this method are sufficiently accurate for adjusting service meters since finer corrections could not be made on the meters themselves.

With an indicating wattmeter the power flowing in a circuit of 50 per cent power factor (or other known power factor) is read. A one to one ratio current transformer of the type used with the watthour meters is then inserted in the circuit and the current for the watt-meter is taken from the secondary of the current transformer. The power is again read. Assuming that a power factor of 50 per cent is used, from the first reading we get $W = EI \cos 60°$ and from the second reading $W' = EI \cos (60 - \alpha)$. The angle α is the angular displacement due to the current transformer. From the above

$$\text{Cos } (60 - \alpha) = \frac{W' \cos 60°}{W}$$

From which we can readily obtain α. Before substituting in the formula W′ should be corrected for error in transformer ratio. The current coils of the watt-meter are again connected directly in circuit and the potential supplied by potential transformers, two transformers being used, one to step up from the line voltage and the other to step down again to the watt-meter. We can now obtain the angular displacement due to the potential transformers by applying the same formula as given above for current transformers. The angle thus obtained for the potential transformers will be twice the angle of one transformer, and as it is the angle of one transformer with which we are concerned the result obtained should be divided by two. This will give us the angle α'. We will then lag the meter, not for 90°, but for $90° - (\alpha - \alpha')$.

Another and quicker way of applying this method is to determine the error introduced by two potential transformers at unity and at 50 per cent power factor. Each transformer is responsible for ½ of the error. Now connect the watthour meter in circuit with the current transformer and with two potential transformers, one potential transformer, stepping up from the line voltage (testing circuit) and the other stepping down to the watthour meter. The indicating watt-meter should be connected directly in the circuit without current or potential transformers. The watthour-meter is than adjusted at unity power factor and at 50 per cent power factor to disagree with the indicating watt-meter by the amount of the error due to one potential transformer. There will be errors due to three transformers, one current and two potential. The watthour-meter is to operate with but two transformers and should be adjusted to compensate for the errors of only two transformers. By not compensating for the error of one of the potential transformers, as outlined above, the desired results will be accomplished.

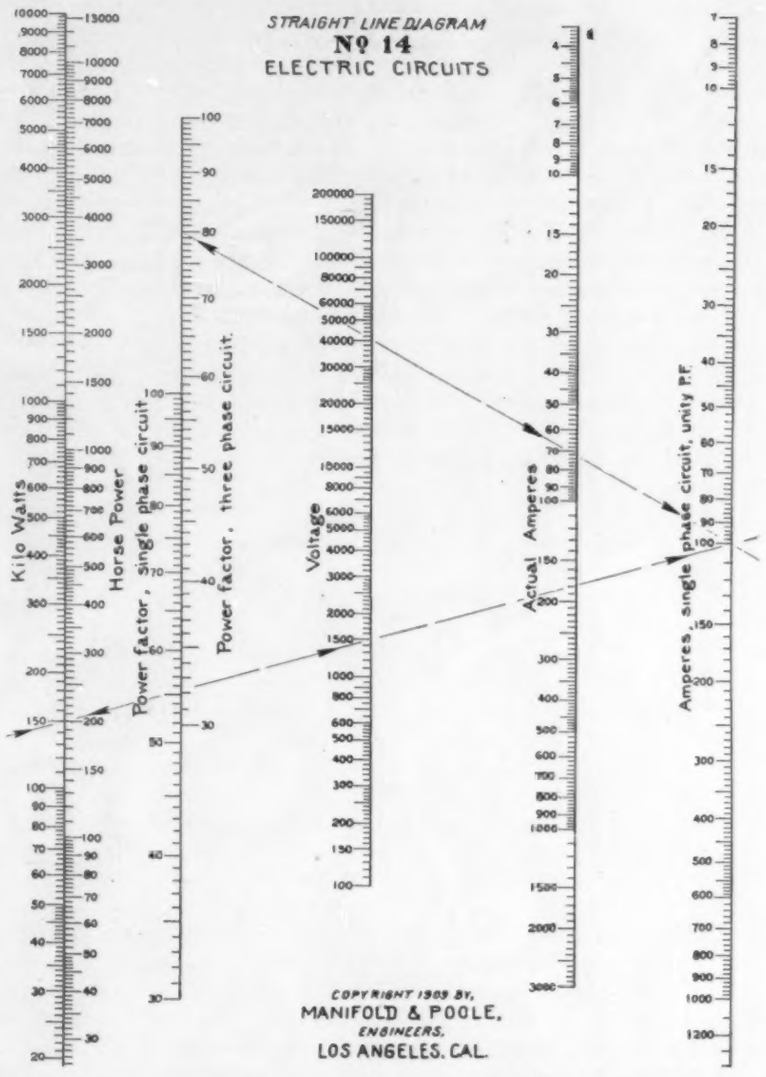
It is not strictly correct to take ½ the error of the two potential transformers, as outlined above, as the error of one transformer; it is, however, very close, closer than adjustments can be made on the watthour-meter.

MECHANICAL CALCULATION OF ALTERNATING WIRING PROBLEMS.

The formidable mathematics that is involved in calculating alternating current electric circuits deters many an engineer from attempting to solve even the simplest problems. It is possible however to perform these calculations mechanically by means of diagrams, among the simplest of which are two printed herewith by permission from Manifold & Poole's "Straight Line Diagrams."

A frequent problem in wiring work is the determination of the volt drop or loss that occurs in transmitting a given number of amperes over a given size wire at a given voltage for a definite distance, or, given any four of these to determine the fifth, such as the size of wire that will cause a given line drop.

With direct current the problem is solved from Ohm's law, E=RI, where E, the fall of potential, is equal to the product of R, the resistance in ohms, and I, the current in amperes. The same relation is true with alternating currents if for the ohmic resistance of a circuit we substitute its impedence, a value which includes the ohmic resistance and the reactance. This latter factor depends upon the frequency, or number of times per second the current reverses in direction, the distance between the wires and the coefficient of self-induction or so-called "electrical inertia," by which the circuit opposes any change in direction of the current.



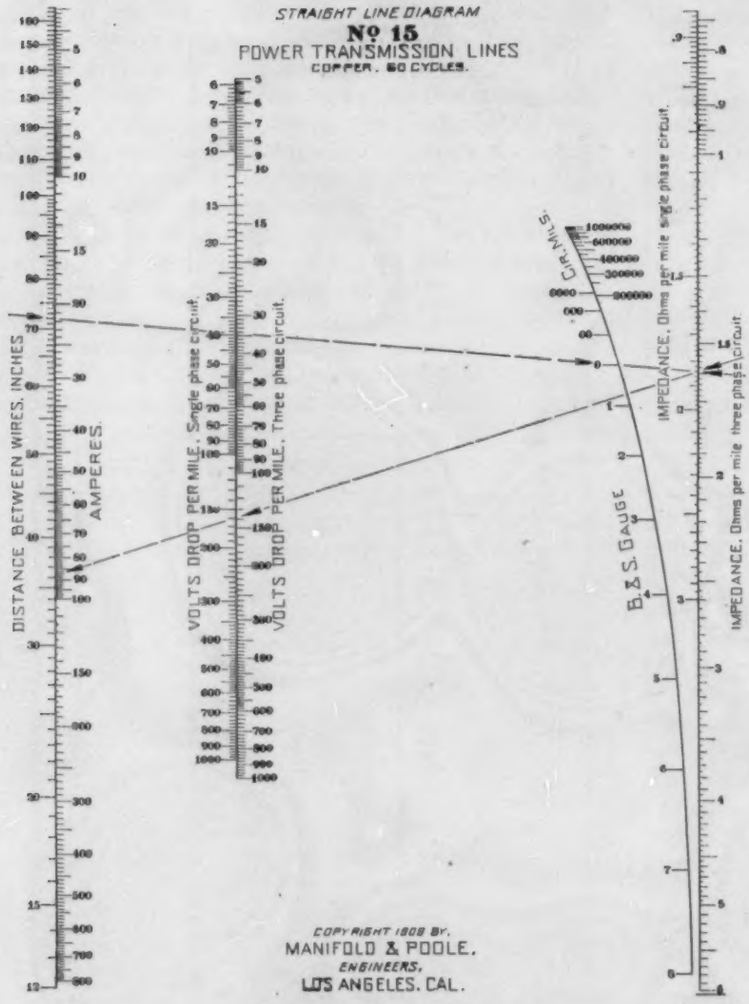
Power in a direct current circuit is equal to the product of volts and amperes (W = E I). In a single phase alternating circuit, due to the induction, the current is not in phase with the pressure or voltage and consequently to show the true power, the product of these values must be multiplied by the power factor or cosine or the angle between them (W = E I x power factor). Where there is no induction the power factor is unity or 100 per cent, decreasing as the induction increases. For three-phase circuits it is necessary to multiply by the $\sqrt{3}$ to obtain the total power (W = $\sqrt{3}$ E I x power factor).

With these facts in mind, to find the volt drop in transmitting power in alternating current circuits, it is first necessary to determine the actual number of amperes from diagram No. 14 and then determine the drop from No. 15.

As will be noted there are seven scales plotted on No. 14; the first scale is laid off from 20 to 10,000 kilowatts, the second gives the equivalent values in horsepower, the fifth is laid off from 100 to 200,000 volts. These scales are so placed that a straight line passing through any value in the first two and any voltage in the fifth will intersect the seventh scale so as to show the number of amperes in a non-inductive circuit. By connecting the values thus determined with the power factor for either single phase or three-phase circuits as marked on scales three and four, the actual amperes transmitted may be read on scale six.

The example indicated by the arrows on No. 14 shows that with 150 kilowatts at 1500 volts, 100 amperes are transmitted at unity power factor, or 70 amperes at 80 per cent power factor three-phase, or reversing the problem, with an 80 per cent power factor three-phase circuit, we find, that, to transmit 70 amperes it will require 150 kilowatts at 1500 volts.

Diagram No. 15 has been made for copper transmission lines at 60 cycles. Scale 1 is laid off proportionally to the distance between the wires from 12 to 160 inches; scale 5 is laid off according to the wire size in the B. & S. gauge from 8 to 0000 wire and from 200,000 to 1,000,000 circular mils. By passing a straight line through the value on scale 1 showing the wire spacing, and the size of wire on scale 5, the impedance in ohms per mile for single phase and three-phase circuits may be read on scales 6 and 7 as shown by arrows. No. 0 wire with 72-in. spacing has an impedance of 1.6 for three-phase circuits and 1.84 for single phase circuits. By passing a straight line through the number of amperes shown on scale 2, as determined from diagram No. 14, and the impedance



on scale 6 or 7, the volt drop per mile for either single-phase or three-phase circuits may be read on scales 3 or 4.

Another problem that frequently arises is to determine the size of wire and the spacing that produces an allowed line drop when a given number of amperes are to be transmitted. This may be accomplished by reversing the process. As shown by the arrows 88 amperes when transmitted with a drop of 160 volts per mile single-phase, or 140 volts three-phase with 72 in. spacing requires No. 0 wire. These calculations assume that capacity effects are neglible.

TARSUS LIGHTED BY ELECTRICITY.

The ancient city of Tarsus, in Asia Minor, has recently been lighted by electricity. In reporting this fact, Consul Edward I. Nathan, of Mersine, says the power is taken from the rapidly flowing Cydnus river. About 1½ miles from the city an 80-horsepower turbine is made to drive a large dynamo, which furnishes sufficient power for 1000 lamps of 16 candlepower each; 450 are now used to light the streets of the city and the remainder will be furnished to private consumers. It is proposed to extend the electric-lighting system to Adana and Mersine, the power to be likewise furnished by the Cydnus river and transmitted by wire to these places.

COMMISSION CONTROL OF PUBLIC SERVICE CORPORATIONS.[1]

BY F. P. ROYCE.

I am to speak today upon matters connected with public service corporations, particularly those doing what may be termed a local business, one which is conducted in a single city or perhaps in a group of adjoining municipalities, as distinguished from those public service corporations whose field of operations is much more extended, usually over more than one state, such as the transportation, telephone and telegraph companies.

Of these "local" companies the most important are those manufacturing and distributing gas, electricity and water for all purposes, street railways and certain telephone companies. The interests of nearly all of the local telephone companies, however, are now so closely identified with the interests of the large corporations doing an interstate business that they are really a part of such properties.

The relations between the public utility companies mentioned and the communities they serve are of such a close character that the results of operation are of direct importance to both. In the first place, in order that these companies may do business at all it is necessary that they should have franchises granting them the right to use the public streets. While it is proper that this should be done, as it makes it possible for the necessary plants to be constructed with the least possible outlay and consequently reduces the capital charge on which a fair return may be earned to a minimum, helping to make the rates for service as low as possible, it is true that the public having granted the franchises to the companies have an interest in the properties and are entitled to certain consideration which they would not otherwise have.

On account of the conditions surrounding these companies they must of necessity be in a sense monopolies; that is to say, they must be free from competition with companies doing the same business in the districts they serve, provided they furnish service of proper standard at substantially as low a price as any other company operating on legitimate lines could do. To undestand this statement it must be seen that the character of the business done is entirely different from almost any other. These companies are all limited in the field of their operations to the exact location of their properties. A gas or electric company can only do business along the line of its permanent distributing system, and a street railway company has no earning power except on its roadbed. Any other manufacturing company producing some portable commodity may develop an unlimited field. If, for any reason, on

[1]Extracts from an address before the Graduate School of Harvard University on May 16, 1910.

account of local conditions, one such company has any advantage over another in one section and the latter company cannot in consequence market its products there, it is free to go elsewhere to develop other fields, but the public utility company cannot do this. When any part of its distribution system is once completed it cannot be moved except at too great a sacrifice. If competition is permitted under these conditions, either one of two things must happen—the company will be unable to earn a fair return on its property or will be obliged to lower the standard of its service to a point where it will no longer be satisfactory to the public served. It is therefore essential to all interested that every community should be served by successful public service companies. Duplications of electrical distribution systems either above or below the streets or of gas distribution systems under the streets are distinctly uneconomical, and in nearly all cases where such duplications have been permitted the ultimate result has been that the two properties eventually became united, with a large waste in the plant really necessary to do the business and consequently a heavy increase in the capital charge.

While gas and electric companies are in competition along certain lines, it is very likely true that this competition may be of a healthy character; and it is also true that each kind of company has a field for business of its own, so that both may succeed while serving the same community.

Certain interesting cases bearing on the propriety of the right of an electric light or power company doing business in any community to be free from competition, have risen in places where such companies generating their current by steam power have operated for a time and later on good water powers have been developed within such distance that the current generated at the water power can be satisfactorily transmitted to the locality already served. If these water powers have been developed at a reasonable cost and actually have a sufficient and fairly uniform capacity of production, it would probably be true that they could furnish current to the community already served by the established company using steam as a motive power at a less cost than could the latter company. In cases of this sort it must be borne in mind that the existing company is only entitled to freedom from competition so long as the community is furnished with energy at substantially as low a price as it could be provided by any other company operating on legitimate lines, being in this instance at the price it could be furnished for by the water power company. The proper solution of such a situation is for the water-power company to sell its product to the existing company, which, in turn, will distribute it to its customers. By doing this a duplicate distribution system would be avoided and the original steam plant of the existing company could be used for relay purposes. By following such a course the existing company could maintain its fair profit and the consumer would have the benefit of a reduction in cost due to the fact that the energy purchased was generated by means of water-power.

In view of the fact that to conduct their business the companies must have franchises granted by the public and also that they should have an opportunity to do business free from injurious competition, the public served have the right to demand that the service furnished by the company should be of a high character, that the company should be willing to make extensions of their lines wherever they are reasonably required and that the prices charged should be fair for the service rendered. The obligations, however, are by no means entirely on one side, and the company which meets these requirements of the public having invested money in good faith in the undertaking has the right to earn a fair return on the value of the property needed to conduct its business and to be free from competition from other companies doing business of the same character in the territory served.

Such companies should so far as possible be free from attack by persons who even though well meaning are ignorant and misinformed in regard to actual existing facts. This is important to the public as well as to the company. For example: if a company doing its business well and fairly is the subject of many unfair statements, it is probable that these statements will have their effect on the holders of the company's securities. It then becomes more difficult for the company to continue its necessary financing and it is obliged to pay more for the money it needs, which must be reflected in higher prices to the public served.

In the early days of these industries their business was of a distinctly hazardous character. There have been times when the future of each was by no means assured, when the earning capacity was a matter of doubt, and in those days it was essential that they should receive the most liberal treatment from the communities served or it would have been impossible to make satisfactory progress and to raise the capital necessary for their development. Today these public utilities are in many cases on a sound basis. Mistakes have been made in many instances; some properties have not been designed with good judgment and are not adapted to the service required of them. Such companies still have a time of uncertainty before them when unusual courage and energy are needed on the part of the operators. In a majority of cases, particularly in the larger communities, the companies have been developed properly; their future is assured so far as can be seen, and it is probably true that the public should now receive more from such successful companies than it formerly did and that such companies themselves are satisfied with somewhat less in the way of future profits than they formerly were. The statements above made as to the rights of both interests are gradually being accepted as sound by them, and there is a growing belief that proper methods should be provided to insure their maintenance.

The best plan that has as yet been devised for this purpose is to provide for the organization of state commissions which have the right to supervise the affairs of public utility companies and the power to adjust certain differences that may arise. It is essential that the duties and powers of these commissions should be limited to supervision and that they should have the right on behalf of the public to see that the rates charged by the companies are fair, that extensions are made wherever they are reasonably required and that the service is as good as should be furnished

under existing conditions. They should also have the right to regulate the issue of securities by the companies and to see that these represent the fair value of the properties. On behalf of the companies, they should have the right to protect them against improper competition so long as they continue to do their duty toward the public served. This plan of supervision by commission has met with growing favor. Massachusetts was the first state to take this step. Twenty-five years ago the legislature passed the necessary laws to provide for the Board of Gas and Electric Light Commissioners and to specify its duties, which have been added to from time to time. The commission now has the right to authorize or refuse the issue of bonds and of stock to be issued by the gas and electric companies. Bonds cannot be issued at less than par, and in the case of stock issues the commisssion has the right to determine the price, not less than par, at which they may be offered proportionately to stockholders. They also have the power from time to time to determine rates for gas and electricity and can order extensions of lines when reasonably required to furnish service to new customers. Similar powers of supervision and adjustment of rates are exercised by the Board of Railroad Commissioners over the street railway companies and by the Highway Commission over the telephone companies. This plan of supervision by commission has now been followed in New York, Wisconsin, New Jersey and other states. With them it has been usual not to follow the Massachusetts plan of having service commissioners but to have one public service commission having the powers mentioned over all public utility companies.

The powers and duties of these commissions are of vital importance and call for distinctly judicial ability in the members. The determination of fair rates for service is one of the most difficult and important. It has now been firmly established by the decisions of the United States Supreme Court that any company is entitled to a fair return on the value of the property owned and necessary to conduct its business, but no general rule applicable to all companies has been determined to establish what a fair return is, and it has been made clear that it will continually vary under different conditions. The history of these public utilities shows that in the early stages of their development their business was hazardous, and at such time those investing their money in various enterprises of this sort were entitled, on account of the risk they ran, not only to a fair income on the money invested but also in case the enterprises succeeded to a gain in their capital. As these public utilities were developed and the permanency of their business became more assured, capital was more readily attracted and could be procured on more reasonable terms. In many cases the companies were successful in making for their stockholders a fair rate of income and also were able to accumulate a surplus. This surplus has sometimes been the subject of criticism, for as it is now possible to get capital for successful companies on a reasonable basis the public forget that within a few years the condition was so different that at that time the money necessary to develop a business could not be procured without the prospect of a large profit, and that if it had not been so procured development would have been greatly retarded and the low cost of production today would have been impossible.

Perhaps the most important rate case recently decided was in 1909, when the United States Supreme Court ruled that an order passed by the New York Legislature, fixing the rate for gas in New York City at eighty cents per one thousand cubic feet, was fair and reasonable. In this decision the Court recognized the fact that the company was entitled to a fair rate of return on its entire property including its "good will," or, as erroneously called, its franchise value, and stated that in the court's opinion such a return should not be less than six per cent per annum in that particular case. It is apparent that no company is more firmly established than the gas company in New York and none are subjected to less danger from possible future developments. Consequently this decision may be fairly taken to mean that public utility companies, when permanently and strongly established, are entitled to a return of six per cent on the value of the property actually required to conduct the business, and it naturally follows that those companies having less stability and less certainty of permanent success are entitled to a higher rate of return.

It is important that the commissions who are called upon to pass on rates should establish approximately what may be called a standard of efficient operation, which, if followed, will entitle the company in question to the rates of return referred to; but, on the other hand, those companies having managements which have shown unusual ability, resulting in decreased cost of operation and unusually low rates to consumers, should be rewarded by an even higher rate of return on their property; otherwise there is not sufficient incentive to the best management. This principle has been recognized in the so-called sliding scale system under which many of the gas companies in England now operate, and which is also followed by the Consolidated Gas Company of Boston.

Companies should be allowed to charge rates which not only permit of fair returns on the investment but which will also be sufficient to provide for necessary depreciation of plant. This is essential, so that there may be at no time any impairment of assets.

The rate of depreciation in connection with the different kinds of public utilities varies materially and it is essential that the commission should have a full knowledge of the facts.

Another of the most important powers of these commissions is to determine the amount of securities to be issued by any company under their supervision. This involves many considerations and in some cases is a more difficult matter even than the determination of fair rates.

The ability of a public service company to procure at reasonable rates the capital required to properly develop its business is probably the most important factor to be considered in connection with these companies today. It is vital to every undertaking that money must be procured or the development cannot go on. In nearly all cases a study covering a term of

years of the operations of these companies will show that the increase in the amount of capital necessary to extend their business as required has been at a greater rate than the increase of the annual gross earnings. That is to say, if a company has shown an annual increase in its business of say 10 per cent it is usually true that the increase in the capital charge has been considerably greater. This has been due to several causes.

1st. The standard of service required has been continually raised and more expensive plants are necessary to meet it than was formerly the case.

2d. The prices for gas and electricity have been continually reduced and a much larger output from any plant is neecssary to produce a given return than was formerly the case, from which it follows that the plant producing the output must have a greater capacity and a greater value for the same monetary return. Furthermore it will be seen that the yearly increase of the capital requirement must be figured on a compounded basis and is consequently of extremely rapid growth.

The ideal plan would be for the entire cost of any property to be represented by an equal amount of permanent securities taken at their par value, but in many cases such a plan would be impossible, as the necessary funds could not be procured on that basis. As has been said, those who invest in such companies when the business is undeveloped and the future precarious are entitled to a profit on the capital invested, and the only effective way to make such a profit possible is to sell securities at a fair and proper discount from their par value. These conditions are true today in connection with certain companies, notably those developing water power in remote sections, where the market for power must be largely developed, and certain lines of new street railways. In such case the plan of selling securities at a discount must still be followed or the money necessary cannot be procured and the important utility will remain undeveloped. Both in the determination of rates and the amount of new securitieis to be issued, it is usually necessary to ascertain the real valuation of the property of the company under consideration. In all such cases the following elements of valuation should be determined:

1st. Structural valuation covering the physical property.

2d. Amount of working capital necessary.

3d. Intangible property.

In considering the structural valuation it is necessary to show the cost of reproducing the property new at the time of its examination, and in doing so the commission must add the cost of employing competent engineers, the interest on capital necessary to pay for the construction but having no earning power during the building period, and the cost of necessary organization. They should also take into consideration the fact that any plant must be built gradually, additions being made from time to time as demand arises, and that the costs of this intermittent on piece-meal construction is much greater than it would be if the entire plant were built continuously at one time.

In considering the value of real estate, any appreciation in land values should be credited to the plant. From the total value so determined must be deducted a fair amount to cover any depreciation that may actually have taken place in any part of the property.

Working capital is as essential as machinery. No company can be operated without coal, oil and supplies, and a reasonable amount of cash must always be on hand to meet any contingency and a fair amount provided for operations.

The principal intangible asset consists in the value of what is ordinarily known as a "going business." This may perhaps be best defined as the difference between the value of the plant as an accumulation of land, building, machinery and supplies and the same property with a developed market and an actual earning capacity.

In order to build up such a business it is always necessary to spend large sums in instructing the public, through advertising, soliciting, etc., in the value of the service to them.

Losses are incurred in making initial installations or extensions of plant which for long periods of time may remain unremunerative. The cost of experimental work is always heavy and structural losses are frequently incurred due to the necessity of changing apparatus to meet new conditions, which changes were in no wise due to the fault of the management. All of these expenses are real, must be borne by the companies and represent actual and permanent value in the successful business development. It is frequently held by the public, but clearly in error, that all of this value of the "going business" is really represented by the franchise, and that as the franchise was granted to the company by the people without cost it is not proper to capitalize it. The fact is that the franchise was merely a permission to use the public highways and that while this mere right to use may in itself represent no part of the property on which the company is entitled to earn a fair return, it is nevertheless true that the business which the company has built up at a large expense after receiving permission to use the highways has a very real value and is an asset of the company on which it is entitled to a fair return.

Having determined the fair valuation of any property which may be represented by securities, the commissions have the power to approve the kind of securities which the management of the companies wish to issue. The companies should procure the necessary money on as low a basis as possible. To do this in connection with the development of any new project a bond issue is usually necessary. This must be for only such an amount that the annual fixed charge representing the interest and perhaps a sinking fund shall be considerably less than the assured net earnings. The balance of money required should be procured by the sale of common stock or, if the project is a large one, by a moderate issue of preferred.

In the states where commissions have been organized, the public utility companies are nearly all on so sound a basis that money for extensions may be secured with little or no discount on the securities and they have not yet been obliged to pass on cases where a large discount on the new common stock issue will be necessary in order to procure the capital needed.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
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Standardizing Engineers

Public safety demands that members of certain professions be licensed before they can practice. Thus, a physician must prove his proficiency in prescribing medicines, and a pharmacist his experience and ability in compounding them. This is a necessary measure for the protection of public health.

No such protection is now afforded against the menace of a badly designed or poorly built engineering structure, which affects the safety of not one, but many individuals, and whose failure furthermore involves heavy financial loss. A mistake in calculating a bridge truss or the foundation of an office building is more disastrous than an error in diagnosing a disease. Poor judgment in selecting a water source or disposing of a city's sewage causes far more sickness than can be laid at the door of the druggist. We allow the veriest tyro to wire our homes for electricity or pipe them for gas, when the slightest fault in their connection is fraught with danger to life and property. The lives of thousands of industrial workers are daily entrusted to the devices of the engineer without a thought as to their proper safeguarding. There is no general law that prevents any man with the smallest smattering of engineering knowledge from opening an office and doing such work as comes his way, provided he can convince others of his ability. This last saving proviso is fortunately effective in eliminating the unfit.

Realizing the necessity of protecting the public from incompetent and irresponsible practitioners and understanding that the present state of affairs is a detriment to the standing of their profession, the American Society of Civil Engineers recently appointed a committee to formulate proposals for laws, regulating the licensing of engineers. This committee finds that there is already a significant trend of legislation in this direction and urges the necessity for uniformity throughout the country, especially as to what constitutes a civil engineer, their definition being:

> **"A civil engineer, within the meaning of this act, is one who practices any branch of the profession of engineering other than military. Said profession embraces the design and construction of public or private utilities, such as railroads, bridges, highways, roads, canals, harbors, river improvements, lighthouses, irrigation works, water supplies, sanitary systems, and the development, transmission and application of power, and includes all industrial, hydraulic, municipal, structural, electrical, mechanical, mining and other works which require experience and the same technical knowledge as engineering schools of recognized reputation prescribe for graduation."**

The suggested requirements for practicing are the same as those for corporate membership in the Society and are to be determined either by membership therein or by State examinations. Similar requirements exist in Quebec, Canada, and licenses are already required for irrigation engineers in Wyoming, civil engineers in Louisiana and land surveyors in Idaho and South Dakota. It is to be hoped that other States will take like action in providing a needed factor of safety.

PERSONALS.

G. McM. Ross, an engineer at Stockton, Cal., is at San Francisco.

C. F. Conn of J. G. White & Co., has returned from a flying trip to New York.

H. C. Eastman, an electrician of Guerneville, was a recent San Francisco visitor.

E. P. Jamison, an iron and steel manufacturer of Seattle, is a San Francisco visitor.

W. D. Thomas, an electrical supply dealer of Petaluma, visited San Francisco last week.

M. F. Jenifer, a telephone official of Los Angeles, spent a few days at San Francisco last week.

Paul Shoup, assistant general manager of the Southern Pacific Company, in charge of electric lines, is at Chicago.

A. C. Sprout, electrical engineer, has been confined to his home in San Francisco for the past week by a slight illness.

F. C. Todt of the Western Electric Company's San Francisco sales force has returned from a successful trip through Nevada.

Thomas Mirk, of Hunt, Mirk & Co., left for Seattle last Tuesday on a steam turbine selling tour for the Westinghouse Machine Company's line.

L. H. Baekeland, junior past president of the American Electro-Chemical Society, attended the convention of the American Chemical Society in San Francisco this week.

S. A. Keith, an assistant engineer at the Humboldt Savings Bank Building steam plant, has just returned to San Francisco from a vacation spent in the Santa Cruz Mountains.

E. O. Wedge has resigned as superintendent of the Consolidated Lighting Company of Montpelier, Vt., to become general manager of the Astoria Electric Company at Astoria, Oregon.

Lee De Forest, a wireless telegraph engineer, has returned from a sea voyage in connection with the installation of a wireless plant on a United States transport service steamer.

V. L. Benedict of the Los Angeles office of the General Electric Company, has resigned to become manager of the Los Angeles Fire Alarm Company, with offices in the Delta Building, Los Angeles.

H. A. Lardner, manager of J. G. White & Co.'s San Francisco office, has been out of the hospital two weeks after a prolonged siege of typhoid fever. He will probably rest about a month before resuming office work.

H. D. Boschken, manager of the California Electrical Construction Company's San Jose branch house, spent a day at San Francisco last week and attended the Electrical Contractors' State Association meeting.

C. A. Tupper, formerly manager of the Allis-Chalmers Company's publicity department, is now actively associated with the Reliance Engineering & Equipment Company at Milwaukee, Wis. He has been succeeded by W. M. S. Miller.

Henry M. Dougherty of J. G. White & Co.'s engineering staff, visited San Francisco during the past week on business connected with the completion of the big dam on the Crane Valley development of the San Joaquin Light & Power Company.

S. V. Mooney, manager of the San Francisco branch of John A. Roebling's Sons Co., who recently returned from a visit to the works reports the eastern wire mills as fairly busy. The Pacific Coast demand for copper wire is rather light.

Willis R. Whitney, head of the chemical department of the General Electric Company, was among the many eminent Eastern chemists who took part in the proceedings of the American Chemical Society's annual meeting at San Francisco during the past week.

F. G. Cottrell, head of the physical chemistry departpartment of the University of California, attended the American Chemical Society's forty-second annual meeting at San Francisco this week and read a paper entitled "The Electrical Precipitation of Suspended Matter."

H. R. King, power apparatus sales manager for the Western Electric Company, is visiting the San Francisco branch, accompanied by F. A. Griffin, the head of the company's commercial department at Schenectady. They are promoting the interests of the new "Hawthorn" line of power apparatus, including both generators and motors.

Among the visiting members from outside points who attended the State Electrical Contractors' Association's meeting at San Francisco last week, were: E. C. Wakeman, Oakland; Mr. Ayres, of Ayres & Stevenson, San Diego; D. T. Griffiths, Berkeley; W. H. McDonald, Los Angeles; W. A. McNally, Pasadena; Mr. Bowers, of Newberry & Bowers, Los Angeles; Mr. Neilson, of Neilson & Smith, Santa Barbara; Mr. Reynolds, of the Reynolds Electric Supply Co., Santa Barbara; C. H. Heilbron, of the Southern Electric Co., San Diego; H. B. Woodill, of Hulse & Woodill, Los Angeles, and J. C. Rendler, Los Angeles. L. R. Boynton attended as director of San Francisco District Local No. 1; J. C. Rendler as director of Los Angeles District Local No. 2; C. V. Snyder as director of Sacramento District Local; Mr. Reynolds as director of Santa Barbara District Local; and W. A. McNally as director of Pasadena District Local.

NEW CATALOGUES.

"Hot Points" for July from the Pacific Electric Heating Company of Ontario, Cal., contains interesting data on "Hot Point" irons.

Bulletin No. 600 from the Sprague Electric Company is devoted to Single Phase and Polyphase Induction Motors of various types and forms.

Sprague Flexible Steel Armored Hose and Couplings are illustrated and described in a booklet from the Sprague Electric Company. These are intended for use with air drills, pneumatic tools, high pressure water and steam.

"Holophane Illumination" for June from the Holophane Co., contains examples of correct illumination and includes the new schedule of prices effective on July 1. Announcement is also made of a new line of reflectors for Mazda and tungsten lights.

American Electric Fuse Company of Muskegon, Mich., have issued their Bulletin No. 350 on Enameled Magnet Wire. This sets forth in easily understood terms the advantage to be gained from using enamel insulated instead of fabric insulated wire, and the complete equipment and facilities which this company has for manufacturing this wire.

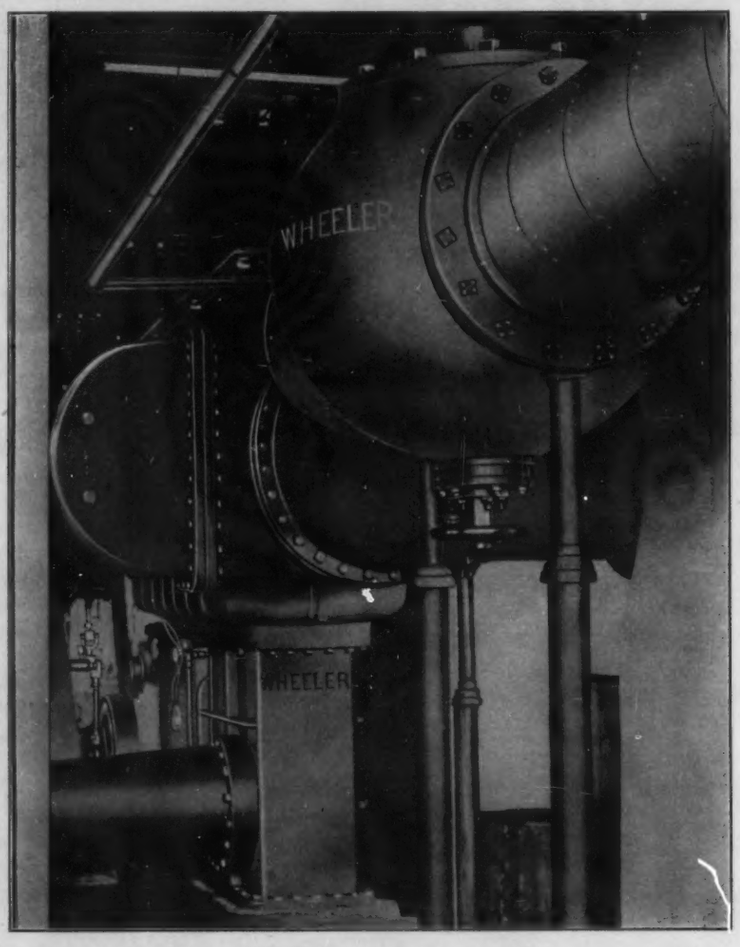
"Battery Charging Rheostats," which has been published by The Cutler-Hammer Mfg. Co. of Milwaukee, describes two types of rheostats for charging ignition batteries and six types for general charging work, for electric pleasure vehicles and for trucks. Full page illustrations of the various types are shown besides several special types such as a motor-generator set panel and a panel for use with a gas engine driven dynamo and storage battery. One section of the booklet is devoted to descriptions and illustrations of protective panels and devices. The applications and advantages of the low current cut-out, maximum voltage cut-out, solenoid switch and overload circuit breaker arrangements are pointed out. These devices prevent overcharging and protect the batteries against damage due to abnormal current conditions.

INDUSTRIAL

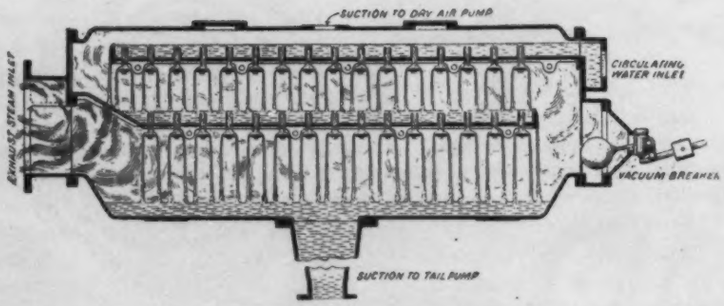
A RADICAL IMPROVEMENT IN JET CONDENSERS.

The great impetus which the study of condenser problems has received during the past few years has resulted in the improvement of the surface condenser so that, whereas a heat transmission of 200 or 300 British thermal units per square foot of surface per hour per degree average difference of temperature was formerly considered acceptable, condensers are now built in which the rate of transmission has been raised to 900 British thermal units and even more. The practical results of this are that with the same amount and temperature of circulating water correspondingly less condenser tube surface will be required, or with the same surface, less, or not so cold circulating water, to maintain the same vacuum.

With the jet condenser, it is not so much a question of improving the rate of heat transmission as of insuring thoroughness of intermixture, that is, of bringing each particle of water so intimately in contact with the steam that it will be heated to the steam temperature and its full capacity for absorbing heat realized. This is desirable in order that the amount of circulating water to be pumped and the power consumed in pumping it may be minimized, and in order that the water from the hot well may be more suitable for boiler feeding, since any loss of temperature therein increases the coal consumption at the rate of 1 per cent of coal for each 10 degrees F. that the final temperature of the circulating water falls below the temperature corresponding to the vacuum. In other words, the hotter the water from the hot well, the less will be the steam required in the feed water heater, or the less the coal required under the boiler, if no heater be used.



New Form of Wheeler Jet Condenser.



Cross Section of Wheeler Jet Condenser.

Complete utilization of the heat absorbing capacity of the water between the temperature at which it is received by the condenser and the temperature corresponding to the vacuum is also to be desired where cooling towers are employed in order that a high vacuum may be realized from comparatively warm circulating water, and further, in order that the water may be delivered to the tower as hot as possible, enabling the latter to get rid of the largest possible amount of heat from a given amount of evaporating surface. Where a condenser is operated in connection with a cooling tower the heat of the steam is transmitted to its final destination, the atmosphere, by two temperature steps, and if the condenser requires a high temperature head in order to perform its work, the less temperature head will there be available for the tower, which will need to be larger in consequence in order to transmit the given amount of heat. If it is a plant already installed, that is, if the amount of tower cooling surface is fixed, it may be necessary to provide the required temperature gradient by raising the upper limit, that is, by having hotter steam in the condenser, which means lower vacuum.

A further reason why the design of a jet condenser should be such that it is not necessary to circulate an excess of water over the theoretical amount in order to condense the steam at any stated temperature and pressure is that even though plenty of cold water be available, so that it is not necessary to work close to the temperature limit, the less water used the less will be the amount of air brought in by it to be pumped out again by the air pump. Indeed, with many jet condensers it is found that the vacuum cannot be improved by increasing the amount of circulating water beyond a certain point, due to the facts, first, that much of the additional water does not come into contact with the

steam, and, second, that the air introduced with the extra water more than counterbalances any benefit gained by lower average temperature of the water.

At first thought it would seem an easier and simpler matter to secure high temperature in the circulating water leaving a jet condenser than in that leaving a surface condenser, since in the jet condenser the water and steam come into actual immediate contact, and in view of the fact that open feed water heaters which are virtually jet condensers, are able to heat water to within one or two degrees of the temperature of the steam entering them. Nevertheless, the fact remains that the water discharged from most jet condensers does not rise nearer than to within 10 to 20 degrees F. of the temperature of the steam.

This failure to realize simultaneously the economy of injection water, the economy of power, the economy of heat, and the high vacuum that would naturally be expected from the jet type of condenser is due to several causes, among which may be mentioned the following: First—Faulty design of the condenser head, resulting in insufficient subdivision of the steam and water, so that some masses of water pass through without having come in contact with steam. Second—Some jet and ejector condensers are so designed that the steam will project itself against the water at high velocity, but such high velocity necessarily means back pressure on the engine or turbine. Third—Lack of adequate provision for withdrawing air, including not only air introduced with the steam, but also that carried in solution in circulating water. Fourth—Lack of adequate provision for cooling the air before it passes to the air pump. Fifth—Where air pumps are used, improper arrangement of parts, so that the air pump may receive steam rather than air from the condenser chamber.

We illustrate herewith a new form of jet condenser recently installed in the power house of an electric railway company by the Wheeler Condenser & Engineering Company of Carteret, N. J. This outfit is installed in the basement beneath a Westinghouse-Parsons 1000-kw. steam turbine. The injection water is taken from a creek nearby, and the warm water is pumped from the condenser head by a Wheeler centrifugal pump, driven by a Wheeler vertical engine. Air is withdrawn by a Wheeler rotative dry vacuum pump, while a Wheeler horizontal relief valve provides outlet to atmosphere in case of stoppage of circulating water.

The salient features of this condenser may be observed in the accompanying cross-sectional drawing, which, however, does not show the exact type of hot well installed in the above plant. The condenser head, however, is identical. Referring to the drawing, the water is introduced at the upper right-hand corner into an extended trough or pan, from which it overflows through numerous short tubes, also at the edge on the extreme left, falling into a second and similar pan provided with similar overflow pipes and weir, and finally falling into the lower part of the shell, and overflowing thence to the barometric column or to the centrifugal or other type of pump serving to overcome the atmospheric pressure.

The steam enters through the opening at the left, passes horizontally across through the shower of water, ascends to the second level, passes to the left through the upper shower, and finally all that is left of the steam vapor together with the air, and other gases, passes horizontally to the right, and over the entering and coldest water at the top to the dry vacuum pump suction opening in the uppermost part of the shell. It will be noted that the cross-section of the passage traversed by the steam continuously diminishes as the volume of steam is reduced by condensation and that, therefore, a uniform steady velocity is maintained throughout, leaving no dead pockets in which air might accumulate. Air is nearly twice as heavy as the same volume of steam at the same temperature, and unless swept forward positively will collect in the lowest part of the condenser shell. In surface condensers it is allowable to place the air pump suction at a low point, but not in jet condensers because of the possibility of water being carried over. In order to lessen the size, and work of the air pump, it is also important that the air may, at the last moment, be in contact with the coldest water.

From the drawing it will be seen that it is impossible for any of the steam to pass to the air pump suction without having traversed all of the sprays. The water is finely divided by the small baffles hung below the tubes. In some of the older types of direct contact condensers, the "condenser cone" was substantially an open chamber in which the hot steam would naturally rise to the top while the air would fall to the bottom, the very opposite of the condition sought, for if the air pump receives steam rather than air all its work is for nothing, while the air keeps on accumulating until the vacuum is seriously impaired.

At the right of the drawing will be seen a float controlling a vacuum breaking valve. In case the water level should rise abnormally in the shell, due possibly to stoppage of the circulating pump, this will break the vacuum upon which the inflow of water will cease, since the circulating water is syphoned up to the condenser head from a lower level. The steam would, thereupon, escape through the relief valve.

Tests made on this condenser in actual service show that the innovations introduced by the designers have worked to good advantage. On the day of the test, the barometer stood at 29.9 inches, while the street railway load on the turbine varied from full load to 10 per cent overload. Temperature readings were taken by thermometers placed in the exhaust pipe and in the hot well, while the vacuum readings were taken from a mercury column connected directly to the condenser.

Results of Tests of Wheeler Rectangular Under Type Jet Condenser.

Vacuum.	Absolute Pressure Ins. Mer.	Corresp. Temp. of Exh. Steam	Injection.		Difference in Temp. betw'n Steam and Cir. Water.
			In.	Out.	
28.65"	1.25"	85.5°	44°	85°	0.5
28.7	1.2	85.	44	85	0.0
28.75	1.15	83.5	44	83	0.5
28.7	1.2	85.	44	83	2.0
28.75"	1.15"	83.5°	44°	80°	3.5
28.75	1.15	83.5	44	81	2.5
28.65	1.25	85.5	44	80	5.5
28.55	1.35	88.5	44	87	1.5
28.75"	1.15"	83.5°	43°	79°	4.5
28.75	1.15	83.5	43	76	7.5
28.6	1.3	87.	43	82	5.0
28.6	1.3	87.	43	82	5.0
28.7	1.2	85.	43	82	3.0
28.65"	1.25"	85.5°	43.5°	82°	3.5
28.75	1.15	83.5	43.5	83	0.5

Although due to the widely varying load on the turbine, it was necessary to set the injection valve to care for the maximum load likely to be carried, it will be noticed that the temperature of the tail water was kept very close to the temperature of the exhaust steam, although due to the coldness of the condensing water available the rise in temperature of the injection water was quite large, and only a comparatively small amount of water was required, a condition unfavorable to close adjustment.

It may be of interest to calculate approximately the ratio of steam condensed to circulating water used. Taking the eighth set of readings, we find a vacuum of 28.55 in. of mercury. Subtracting this from 29.9, the barometer reading. Peabody's Tables, this corresponds to a temperature of 88.5 leaves 1.35 in. of mercury steam pressure. According to degrees F., although the reading of the thermometer in the steam space at the same instant was 90 degrees F. The latent heat of steam at 88.5 is 1042 British thermal units. To cool the condensate from 88.5 degrees F. to 87 degrees F., the temperature of the outgoing condensate, will give 1.5 more heat units, or 1043.5 in all. The entering temperature of the circulating water is given as 44 degrees F., and the

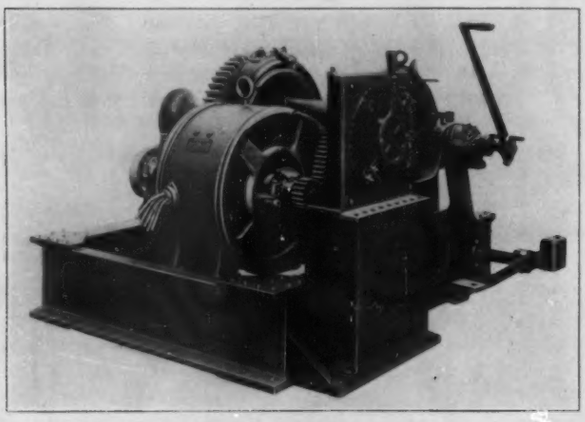
final temperature is 87 degrees F., between which limits each pound of water will absorb 43 heat units. Dividing 1043.5 by 43 we have 24.3 as the number of pounds of circulating water required to condense one pound of steam.

As a matter of fact, the amount would be less than this, since not all of the exhaust is steam when it arrives at the condenser, some of it having already condensed in the turbine and in the exhaust pipe, due to work performed and to radiation. Suppose that 10 per cent of the steam is water, that is, that the quality of the exhaust is .90. Taking 90 per cent of 1042, we have 940, adding 1.5 makes 941.5, and dividing by 43 gives 21.9 as the ratio of the circulating water to steam.

PORTABLE ELECTRIC HOISTS FOR RENTAL.

Novel ideas, when practical, are at a premium. Their speedy adoption and modification to meet local conditions, mark the progressive engineer, the energetic salesman and the growing industry. "Practical novelty" is the key note of all modern enterprise; it has, however, for obvious reasons found a broader exemplification in the electrical field than elsewhere. The accompanying illustration shows a portable hoisting outfit designed by the Rochester Railway & Light Company, and equipped with a Westinghouse motor. The design has proven very effective and has been duplicated for a considerable number of central stations and contractors.

In addition to those already sold, the Rochester Railway & Light Company has retained two completely equipped



Portable Electric Hoist.

hoists in stock for rental to contractors, at a nominal charge of two dollars to cover costs of delivering and installing the hoist. For local service direct-current motors are used. Several alternating-current motors, which can be mounted interchangeably with the direct-current motors, are also held in stock and substituted when the hoists are to be used in outlying districts of the city. No extra charge is made for changing the motors.

The advantages of an electric hoist are numerous and striking. It is compact, durable and self-contained; fuel and water supply need not be considered; the smoke nuisance is eliminated; depreciation at all loads are insured. When equipped with an electric brake, the hoist is absolutely automatic, a single lever giving both power and brake control. In case of interruption to service the electric brake is automatically set, while a mechanical brake actuated by a foot lever affords additional protection. A suitably arranged friction clutch allows the drum to rotate independently of the motor, when lowering the load.

The cost of hoist complete as shown is $800.00
Without electric brake 700.00
Capacity 2000 pounds at 200 feet per minute.

Actual average cost of continuous operation at rated capacity on recent construction, 60 cents per day.

The motor equipment includes d. c. 15 h.p. Westinghouse type S, 1000 r.p.m., back-geared to give a countershaft speed of approximately 230 r.p.m. R-28 controller and resistance; or a. c. 15 h.p. Westinghouse type HF, 1120 r.p.m., back-geared to give a countershaft speed of approximately 230 r.p.m., intermittent service type FA reversing controller.

THE HOLTZER-CABOT SPARK COIL.

The Holtzer-Cabot Electric Company of Boston and Chicago are the manufacturers of a high-tension jump spark coil which is the result of over a year's experiment in an especially equipped laboratory and extensive tests under actual service conditions with several cars of various models in use at the factory.

In addition to those important features, namely, a spark of great intensity and economical battery consumption, the makers have devised several exclusive attachments which greatly add to the value of their coil. It is assembled on the "unit" plan, each unit having knife switch contacts for the primary wires and a spring contact for the secondary connection.

The trouble as well as expense of platinum renewals has been practically eliminated by the introduction of a polarity switch into the coil circuit. This switch performs the regular duty of a starting device and with it two batteries or one battery and a low tension magneto can be used. The principle involved is, that reversing the polarity neutralizes the electrolytic action upon the platinum points and thus will effectually prevent any building up or pitting. This switch, therefore, is doubly welcome to the autoist, as it not only saves many a cash outlay but also guarantees a greater degree of smooth running. The rapid "snap" action in changing over from battery No. 1 to battery No. 2, or from battery to magneto, does away with any chance of the jerk of engine due to misfiring.

A safety spark gap in a glass tube protects the winding and condenser from a discharge, so that a secondary wire if broken cannot work damage to the equipment. The construction of the gap will allow of a means of testing in absolute safety without the possibility of a shock to the operator. Trying out the coil when looking for trouble is reduced to the work of a moment, for by removing the secondary plug contact by a slight pull, if the coil is in working order, the spark will at the proper moment jump across the gap. The means of securing a destructive flame from the coil are besides the general construction of the coil found to a large extent in the high velocity and wide adjustment of the vibrator armature.

All terminals entering this coil are covered by a neat section of the same design as the removable top. The coil itself is worked up complete from the raw material in the plant of the Holtzer-Cabot Company, this including cabinet work and finishing, screw machine work, winding and assembling. A part of the large Brookline factory will be devoted to the production of spark coils and orders are being taken for immediate shipment from stock. The company has just issued a bulletin No. 157B describing their line of magnetos and spark coils.

TRADE NOTES.

Eccles & Smith Co. of San Francisco, Portland and Los Angeles, have been made Pacific Coast representatives of the Cutter Electrical & Manufacturing Co.

The Western Wireless Telegraph Company has installed new wireless telegraph instruments on the Revenue Cutters Bear and McCulloch, which recently left San Francisco for the far North.

It is announced that the Platt Iron Works Co. was the successful bidder for three turbine wheels of over 8000 horsepower each, for the Portland Railway Light & Power Company's extension in Oregon. The contract price is said to be $140,000.

NEWS NOTES

INCORPORATIONS.

BOISE, IDAHO.—The Bear & Lick Creek Power Company has been incorporated for $500,000 by S. D. Gosbert.

PORTLAND, ORE.—The Southern Oregon Water Company has been incorporated by W. T. Barnett, E. T. Zork and C. S. Grani with a capital stock of $20,000.

WINLOCK, WASH.—Drew's Prairie Telephone Line Association has been organized to build a farmers' telephone line from the town of Winlock to surrounding farms.

PRINEVILLE, ORE.—The Cone Power Company has been incorporated by local business men with a capital stock of $50,000. W. Booth is the president of the new company.

FINANCIAL.

BANDON, ORE.—The people of Bandon at the city election have voted a bond issue of $60,000 for a municipal water works.

SACRAMENTO, CAL.—Trustee Carragher has presented a resolution to the Board of Trustees calling for a bond election for $666,000 for the erection of a filtration plant to clarify the water of the Sacramento river.

SANTA BARBARA, CAL.—The City Council has paved the way for calling an election for water bonds in the sum of $200,000 by adopting a resolution of intention to this end. The actual calling of an election will follow at another meeting.

EL PASO, TEX.—El Paso is to have municipal ownership of water works. This was decided when 431 voters declared last week that $375,000 in bonds necessary for the purchase of the present plant should be issued while opposing their issuance were 144.

NAMPA, IDAHO.—Bonds of $20,000 for a water works system in Meridian have been received in that place from Otis & Hough of Cleveland, Ohio, and the new system will be started at once. The entire work of construction will be in charge of Edmond Blake, a civil engineer of Boise.

OCEANSIDE, CAL.—City Attorney Johnston has been directed by the Trustees to prepare legal papers for an election to vote on the question of a bond issue for $15,000 for improvement of the municipal water system. The principal item is for the replacement of 8000 feet of wooden main with cast iron.

HUNTINGTON BEACH, CAL.—The City Council has passed an ordinance calling a special election to be held in this city on July 25th to vote on a proposition bonding the city for $2000 for purchasing land upon which to erect a gas plant and $37,500 with which to erect the plant. Bonds will bear five per cent interest per annum.

VALLEJO, CAL.—The City Trustees have voted to call an election to submit to the people propositions for bonding the city for $90,000, for improving the water system and $75,000 for the city's share of the joint city hall and branch county jail for which Solano county has given $50,000. Propositions to bond the city for installing and operating an electric light plant and for an intersecting sewer were defeated.

SPOKANE, WASH.—S. Z. Mitchell, president of the Electric Bond & Shares Company of New York, the financial subcorporation of the General Electric Company and allied electric interests, has obtained an option on a controlling interest in the Hanford Irrigation & Power Company of Seattle, for a consideration said to be close to $750,000. The Hanford company owns valuable water rights on the Columbia river at Priest Rapids, where there is sufficient power to generate 100,000 electric horsepower.

TRANSMISSION.

SPOKANE, WASH.—Work on the 2000 foot tunnel project under the Spokane river has been started by the Washington Water Power Company.

VICTORIA, WASH.—A favorable report was received on the extensions of the Stave Lake Power Company and the company's plans approved.

REPUBLIC, WASH.—The North Washington Company, which owns and operates the power plant at this place, has leased the plant at Oroville and will build a 45-mile power line to this place.

MARICOPA, CAL.—The West Side Electric Company of this place have interested eastern capital and have resumed operations after a three-months' shut down. They expect to furnish electricity for both lighting and pumping purposes in the West Side fields.

ELLENSBURG, WASH.—The Cle Elum Falls Power Company has filed a water right with the county auditor, appropriating 5000 cubic inches of water per second from the Cle Elum river to be used in producing power. J. C. Donnelly of Tacoma is president of the company.

LONG BEACH, CAL.—Another contract for work on the new plant being erected on Long Beach harbor by the Southern California Edison Company has been awarded to the Weber-Duller Company of Los Angeles. This contract is for all chimney work connected with the big power plant.

LOMPOC, CAL.—The Pacific Coast Ltd. Oil Company has installed an electric plant for the treatment of oil to separate the water from the oil. The installation is under the supervision of Professor Wright of Berkeley, who is the inventor of the system. If such an invention proves a success it will be a boon to oil operators who have a large amount of water in the oil.

CHIHUAHUA, MEX.—The Mayo River Power & Land Company of Denver, a corporation organized with a capital of $5,000,000 U. S. currency, to develop hydroelectric power on Mayo river in western Chihuahua and eastern Sonora, and for which it acquired a federal concession over a year ago has its hydraulic engineer R. M. Jones and his assistant examining several rivers in Sinoloa. The first dam location has been made and plans and specifications of the dam and power plant have been made.

WASHINGTON, D. C.—Ten withdrawals of water-power sites in California were made by President Taft in the orders from Beverly a week ago. The affect strips of land along the Pitt, Susan, Yuba and North Fork of the Feather rivers in Northern California, the Stanislaus, Mokelumne, Tuolumne, Fresno and Kings rivers in Central California and the East and West Walker rivers in the Mono Lake region. The area of land withdrawn totals 47,819 acres. These withdrawals are of public lands outside the national forests.

SAN FRANCISCO, CAL.—Everything of value belonging to the Sierra Nevada Water & Power Company, operating in Calaveras county, has been sold by Sheriff Joshua Jones for the benefit of creditors of the defunct Market Street Bank of San Francisco and unpaid laborers at work on the company's projects, for $14,000. The return of the sale, together with the payment of the receipts therefrom, to the legal representatives of Milton Bernard, assignee, was made to the Superior Court today. It marks the end of a long legal battle, and at the same time gives to the laborers about $6000 that they have been waiting for for nearly a year.

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ILLUMINATION.

MEDFORD, ORE.—J. R. Anderson purchased a tract of land about a quarter of a mile south of Voorhies on which to erect his gas plant to supply Ashland and Medford.

LOS ANGELES, CAL.—The Board of Supervisors has passed an ordinance granting a franchise to the Domestic Gas Company to lay gas pipes in certain public highways in this county.

EUGENE, ORE.—Chief Engineer H. H. White of the H. H. Byllesby company's gas plants, announces that the company expects to put in seven miles of additional gas mains in this city.

LOS ANGELES, CAL.—The Gas & Electric Co. (Baker Iron Works, contractors) will erect two 5-foot gas distributing drums complete, at the compressor station at Jackson and Ducommun streets, Los Angeles.

PHOENIX, ARIZ.—The Pacific Gas & Electric Company has specifications out and is calling for bids on new apparatus for its gas plant. These specifications cal' for new gas generator and a new 200,000 foot gas holder, also several miles of 10-inch and 12-inch pipe to increase the serving capacity of the mains.

TRANSPORTATION.

WHITE SALMON, WASH.—C. M. Wolfard is promoting an electric railway for this section to be about 60 miles in length.

ST. ANTHONY, IDAHO.—A scheme is on foot, promoted by the Commercial Club, to build an interurban line from this place to Parker, down on the bench to Egin, etc. Over $12,000 has been subscribed toward the project.

PORTLAND, ORE.—Bids have been requested for the construction of 50 miles of line for the United Railways Company from Glencoe to Bay City. Only certain contractors were asked to bid. A contract was let to Porter Bros. for 11 miles of road from Burlington to Glencoe. The contract for substation equipment was let to the Westinghouse Electric Company.

OAKLAND, CAL.—An ordinance granting the San Francisco, Oakland and San Jose Consolidated Railway a franchise to 1000 feet of the western waterfront for wharves, docks and terminal facilities, has been given its final passage by the City Council. In the near future the company is expected to begin the work of improvement, upon which it will expend in the neighborhood of $5,000,000.

LOS ANGELES, CAL.—Grading on the proposed Pursell electric road right of way has begun. The road is to run from San Diego to Escondido. The work now consists of the leveling to the road bed of the old belt line railroad in the city park at San Diego along which the right of way of the new road now extends. The franchise provides that the road must be completed to El Cajon within 1 year and to Escondido within two years after the work is commenced.

SAN FRANCISCO, CAL.—T. M. C. Flannery and W. Flannery, stockholders in the Western Rapid Transit Company, charge a number of the other stockholders with misappropriation of the company's funds in a suit filed with the county clerk last week. The defendants are R. A. Crothers, A. H. Hayes, Horace Wilson, Wm. Wilson, Jas. S. Murphy, G. O. France, N. L. Wilson, D. L. Crosbie, H. M. Wright, W. P. Twist, Lilian G. Twist, G. Stevens, L. M. Fairchild and J. I. Plunkett. The entire capital of the organization is $250,000. Over $200,000 has been paid into the treasury, it is claimed and misappropriated by the incurring of debts said to be contrary to the statutes. The plaintiffs particularly object to an alleged transfer of the company's property to corporations outside of the State. An accounting is demanded.

WATERWORKS.

JOSEPH, ORE.—Bids will be received by the city of Joseph, Ore., until 8 p. m., July 20th, for the construction of a water works system for Joseph, Ore.

BAKERSFIELD, CAL.—By unanimous vote the electors of the Standard School District have voted $8000 for the improvement of the school. A water system will be installed, playgrounds improved and added to and the money used for the betterment of the school in every way.

LONG BEACH, CAL.—The City Council passed an ordinance granting to F. A. Green the right and privilege for a period of 21 years to take water for cooling purposes from the entrance channel of Long Beach harbor and to discharge the water when used into the ocean, and for that purpose to operate and erect a conduit.

SPOKANE, WASH.—Bids in triplicate will be received at the office of the Constructing Quartermaster, Fort Missoula, Montana, until 9 a. m., July 30, for the construction of a water distributing and sewer system to be received separately or jointly, addressed to B. Shattuck, Fourth Infantry, Constructing Quartermaster.

GILROY, CAL.—County Surveyor J. G. McMillan has been called here by Supervisor H. S. Hersman for the purpose of running levels from the Goodrich place on the Old Hot Springs road to the Hecker ranch on the Ferguson road, a distance of about three and one-half miles. This is done with a view of putting in a water system and supply water.

LIBBY, MONT.—G. Stanton, E. Barnum and C. Proctor of Great Falls have been in Libby for several days with the intention of securing a franchise to put in a gravity water system. They also wish to secure an electric lighting franchise, and are negotiating with the telephone company to take over the telephone franchise granted some months ago.

BELLINGHAM, WASH.—A petition presented to the water board by C. O. Greenfield asking for the installation of a water main from the present city limits along the Guide Meridian road, has been granted. It is estimated that a main 632 feet long would be required for this service at a cost of about 25 cents per foot and that the entire cost of the new main would mean approximately $200.

SAN FRANCISCO, CAL.—Sealed proposals in triplicate for constructing a reservoir wooden tank, extending mains, etc., at Fort Barry, Cal., will be received here up to 11 a. m., August 6, 1910, and then opened. Plans, specifications, blanks and necessary information can be obtained here. A deposit of $10 is required to insure return of plans, etc. Envelopes containing proposals, to be marked "Proposals for reservoirs, etc., Fort Barry, Cal.," and addressed to Major George McK. Williamson, Quartermaster, U. S. A.

SAN JOSE, CAL.—Argument in the case of the Hayes-Chenoweth Company against the Bay Cities Water Company, an action in which the plaintiff is attempting to restrain the water company from appropriating the waters of Coyote Creek, has begun before Judge Welch. Attorneys John E. Bennett and C. D. Wright for the water company ask leave of Judge Welch to amend their pleading, so that the case will cover the excess waters of the river instead of being so broad as the former suit. It is argued on the part of the water company that no injury would be done the orchardists who have artesian wells along the river, which affects to a greater or less degree every well in the Santa Clara Valley, should the water company only use the excess flow and not touch the large volume of water that percolates the gravel and furnishes the supply for the many artesian wells of the valley. Judge Lieb for the plaintiff, on the other hand contends that should the water company be allowed to use the amount of water that it claims it has a right to appropriate it would affect every well in the valley.

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Sprague Electric Co. 2
New York City, 527-531 W. 34th.
San Francisco, Atlas Bldg.
Seattle, Colman Bldg.

Standard Und. Cable Co. 1
San Francisco, First National Bank Bldg.
Los Angeles, Union Trust Bldg.
Seattle Office, Lowman Bldg.

Star Expansion Bolt Co. 5
New York City, 147-149 Cedar.

Sterling Paint Company, 11
San Francisco, 118 First.

Swayne, R. B. 11
San Francisco, 813 Postal Telegraph Bldg.

T

Technical Book Shop 13
San Francisco, 604 Mission.

Tel. & Elec. Equip. Co.
San Francisco, 612 Howard.
Los Angeles, Security Bdg.
Seattle, Alaska Bldg.
Portland, Couch Bldg.

Thomas and Sons Co., R.
New York, 227 Fulton.
East Liverpool, Ohio.

Tracy Engineering Co. 4
San Francisco, 461 Market.
Los Angeles, Central Bldg.

V

Vulcan Iron Works 1
San Francisco, 604 Mission.

W

Western Electric Co. 3
San Francisco, 680 Folsom.
Oakland, 507 16th.
Los Angeles, 119 E. 7th
Seattle, 1518 First Ave. So.

Western Wireless Equipment Co. 4
San Francisco, Grant Bldg. 7th and Market.

Westinghouse. Elec. & Mfg. Co. 6
Pittsburg, Pa.
Los Angeles, 527 So. Main.
Denver, 429 17th.
Seattle, Central Bldg.
Salt Lake City, 212-214 So. W. Temple.
San Francisco, 165 2d.
Spokane, Columbia Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.
Canada, Canadian-Westinghouse Co., Ltd., Hamilton, Ontario.
Mexico, G. & O., Braniff & Co., City of Mexico.

Westinghouse Machine Co. 6
Pittsburg, Pa.
San Francisco, 141 Second.

Weston Elect'l. Instrument Co. 14
Waverly Park, N. J.
New York, 114 Liberty.
San Francisco, 682-684 Mission.

Wilbur, G. A.
San Francisco, 61 Second.